Annual Report to the Twenty-First Legislature
2001 Regular Session

On

ACT 152
SLH 200 (HB 2835, HD2, SD2, CD1)

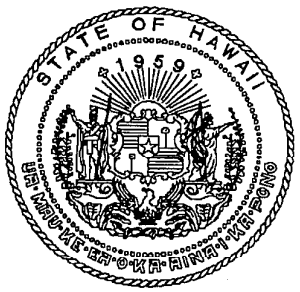
RELATING TO WATERSHED PROTECTION

Prepared by the

Department of Land and Natural Resources
State of Hawaii

Honolulu, Hawaii

October 2001



BENJAMIN J. CAYETANO
Governor

DEPARTMENT OF LAND AND NATURAL RESOURCES

GILBERT S. COLOMA-AGARAN, Chairman

TIMOTHY E. JOHNS

KATHRYN W. INOUYE

FRED C. HOLSCHUH

TED K. YAMAMURA

LYNN P. McCRORY

DEPARTMENT OF LAND AND NATURAL RESOURCES

GILBERT S. COLOMA-AGARAN, Chairman

JANET E. KAWELO, Deputy to the Chair
LINNEL T. NISHIOKA, Deputy for the
Commission on Water Resource Management

ACKNOWLEDGEMENTS

The following government entities assisted the
Department of Land and Natural Resources in compiling this report:

U.S. DEPARTMENT OF THE ARMY
Directorate of Public Works
U.S. Army Garrison Hawaii

DEPARTMENT OF AGRICULTURE
State of Hawaii

HONOLULU BOARD OF WATER SUPPLY
City and County of Honolulu

DEPARTMENT OF WATER SUPPLY
County of Hawaii

DEPARTMENT OF WATER SUPPLY
County of Maui

DEPARTMENT OF WATER
County of Kauai

TABLE OF CONTENTS

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY

Introduction:

During the 2000 legislative session, the Legislature passed Act 152. Act 152 created a watershed protection board comprised of the chairpersons of the Department of Land and Natural Resources and Department of Agriculture, the county water managers from each of the four counties, and a representative from the United States Military. The board was charged to develop a watershed master plan to include:

(1) Identification of potential watershed management areas to be protected;

(2) Development of criteria for eligible watershed management projects;

(3) Development of procedures and criteria for selecting eligible watershed managementprojects;

(4) Designation of watershed management projects, including the amount of funds needed for such projects;

(5) Development of an implementation plan for those designated watershed management projects;

(6) Identification of potential sources of funding, including appropriations, assessments, contribution, grants, donations from public and private sources, and recommendation of funding sources;

(7) Analysis of problems and issues encountered in the equitable levy, assessment, and collection of the watershed protection assessment on water users; and

(8) Any other issues designated by the board.

The board was charged to submit the watershed protection master plan to the legislature no later than June 30, 2001. Act 152 sunsets on June 30, 2002.

Background:

Hawaii's forested watersheds, both native and non-native, are vital recharge areas for Hawaii's underground aquifers and a dependable source of clean water for its streams. At the turn of this century, public and private concerns helped set-aside over 1.8 million acres of forest cover into forest reserves further protecting Hawaii's water resources. Today, Hawaii has the 11th largest State-owned forest and natural area reserve system in the United States. However, our forested watershed is declining in both area and quality, threatened by invasive weeds and feral animals. A healthy watershed forest is no accident. It is the result of the investment that was made in good watershed management many decades ago with the creation of the forest reserves and massive reforestation efforts thereafter.

Today, an integrated watershed forest management program may include all of the following activities: fire control and prevention; stream monitoring; reforestation; detection and rapid response to remove invasive weeds; monitoring for pest insects and disease; maintenance of trails and accesses for

public hunters; fencing and animal removal in priority watersheds; and public education & volunteer programs.

The concept of watershed partnerships as a means of watershed protection has been going on for close to ten years. Watershed partnerships are voluntary alliances of public and private landowners committed to the common value of protecting large areas of forested watersheds for water recharge and other values. The successful creation of the East Maui and West Maui Mountains Watershed Partnerships have reinvigorated the historic cooperative partnership of public and private sectors in working together to protect essential forested watershed recharge areas in Hawaii. In 1999, the Koolau Mountain Watershed Partnership on the island of Oahu and an East Molokai Watershed Partnership were also formed. A watershed partnership for the island of Lanai should be established this year. Nothing in this report is meant to discourage those continuing efforts underway. One of the purposes of this report was to look at the issues concerning a dedicated source of funding for current and future watershed protection projects.

Findings and Recommendations:

1. The board decided that given the huge undertaking to come up with a watershed master plan and given the limitations of time and resources that the phased approach would allow the initial report to focus in on achievable targets based on the priority identified in Act 152 of the forested recharge areas. Expanding the watershed master planning effort to include the entire Ahupua'a would be the focus of a subsequent master planning effort. Ultimately, a total of four phases have been identified, as follows:

- Phase 1 Framework for the Watershed Protection Program
- Phase 2 Watershed Assessment and Prioritization (Mauka Areas)
- Phase 3 Watershed Master plan for the Mauka Areas
- Phase 4 Watershed Master Plan for Mauka and Makai Areas (Ahupua'a).

2. A management plan must include the following components:

-watershed resource monitoring, including rainfall, aquatic biological data from streams, hydrological information, water quality, forest health and species diversity.

-feral animal control

-non-native weed control

-polluted runoff and other pollution in the watershed area

-management instructure, roads, trails, shelters, helicopter landing sites to do forest restoration and watershed resource monitoring work

-public education and volunteer outreach program, including a program to educate and train the public at large and communities on watershed issues. A community outreach program that includes capacity building citizen based watershed restoration and partnerships with stakeholder groups.

3. There are already five existing watershed partnerships located on East Maui, West Maui, East Molokai, Koolau mountains on Oahu, and Lanai. Those efforts should be supported with adequate funding.

4. The assessment of each watershed management project can be facilitated by the development of a set of criteria that will

identify the physical, social and cultural parameters of each watershed. There were two basic groups of criteria that could apply to watershed management projects, 1) Watershed significance criteria based on resource values or conditions that impact water quality and quantity, and 2) the ability to deliver effective watershed protection programs.

5. Criteria for eligibility should be simple and easily understood. Information submitted for the application, screening and selecting procedures should suffice to demonstrate that some or all of these criteria have been met. Projects should not have to meet every criterion, but should demonstrate sufficient eligibility to be considered. Procedures for selection of eligible watershed projects should enable sound decision-making, without creating the need for a heavy administrative structure to implement. Procedures and criteria should generate sufficient data to facilitate the weighing of the selected parameters with confidence, and yet they should do so without being unduly burdensome for the applicant or implementing board.

6. Implementing watershed protection projects is a multimillion-dollar undertaking. A multi-million dollar expense may seem like a lot of money, but an analysis of the resources at stake justifies the investment. In November 1997, a team of economists at the University of Hawaii began a natural resource valuation of the Koolau Mountains watershed on the island of Oahu. Their preliminary economic analysis of the amenities provided by the Koolau Mountains watershed show an estimated Net Present Value (NPV) of $7.44 to $14 billion. (Roumasset, J. et. al., 1997).

7. It is important and critical to the success of watershed projects that they be supported by a combination of funding sources including agency appropriations, grants, contributions from public and private sources, landowners, water purveyors, and other beneficiaries of watershed protection programs. As well, a dedicated source of funding, whether it is a portion of an existing tax or a new assessment or tax on water use should be considered. Funding through the general fund would be more equitable in distributing the burden of this tax on all water users in the State, however it is acknowledged that general funds are subject to changing budget priorities and are not a source of dedicated funds.

8. There was agreement that the Conveyance tax should be looked at as a source of dedicated funding for watershed management. Since 1993, two successful DLNR programs have had a dedicated permanent source of state funding: the Natural Area Partnership Program (NAPP), which provides state matching funds on a 2:1 basis with private funds for the management of natural resources on private lands permanently dedicated to conservation; and the Forest Stewardship Program (FSP), which provides State matching funds on a 1:1 basis with private funds for the forestry and forest management on private lands for ten-year periods. These programs are funded by 25% of the Conveyance Tax (HRS 247), which is levied each time real estate property is bought or sold, with revenues deposited in the Natural Area Reserve Fund. The nexus is clear for use of a portion of the Conveyance Tax as the sale, development, and improvement of real estate in Hawaii puts additional pressure on Hawaii’s water resources and increases the need and costs to protect watershed recharge areas.

9. A watershed protection assessment on all water users must consider policy, legal and equitable issues. There are serious policy issues that must be addressed prior to the imposition of any assessment. Additionally, the legal issues on assessment versus taxation, equality and legal nexus of the assessment, collection of a state assessment by county agencies must be addressed prior to the imposition of any assessment. There was consensus that any assessment must be fairly applied to all water users, e.g. municipal, agricultural, military, private water systems.

10. The watershed protection assessment should be based on a completed assessment and prioritization of watershed and water resource needs and issues, and an accountability plan for expending the funds. The plan should include options to fund watershed protection activities.

In order to determine a sound basis for a watershed funding assessment for new watershed projects, a watershed protection master plan that addresses watershed identification, watershed project selection, project implementation, prioritization and should be completed before the final funding needs and assessment methods can be determined.

11. A commitment to funding watershed protection programs should be provided by all beneficiaries including government agencies, landowners, watershed partnerships and the public.

Recommendations for Follow Up Actions:

Act 152 sunsets in July 2002 and in the remaining year of this Act, there are many objectives that could be completed to base a

more thorough budgetary proposal to the legislature. But this would be subject to legislative approval for additional appropriations. The following areas comprise potential next steps for the watershed protection board. These measures would all require additional funding for the board.

1. Watershed Protection Board: The present board believes that should the Legislature desire to retain the watershed protection board and to extend its sunset date or eliminate the sunset date completely that three areas need to be considered. First, the composition of the board should be reworked to include scientific, landowners, and community members. Second, the Legislature must provide funding for additional work of the Board. The board cannot continue to function without the addition of staffing and other resources to properly get the job done. Third, one of the major functions of the board is to provide coordination between existing programs to make sure that resources are not wasted and to provide for the maximum coordination of many different existing programs.

2. Complete the List of Critical Watershed Management Areas.

3. Complete the Watershed Data Collection and Prioritization Assessment. More work is needed to focus or “distill” the criteria into their essential elements and complete the watershed assessment and prioritization process in a timely period.

4. Develop a List of Tailored Watershed Protection Projects. Once the prioritized list of critical watershed management areas are identified, a secondary assessment could evaluate the potential effectiveness of each type of watershed protection

project that would be specifically tailored to the unique needs of each watershed management area. This step is critical to effectively utilize the limited available funding.

5. Secure a Dedicated Funding Source and Project Specific Appropriations.

6. Integration of Various Watershed Efforts and Programs. There is a need to integrate all of these efforts into an efficient and focused framework.

7. Develop and Implement a Stakeholder Coordination and Involvement Plan. A stakeholder and public participation strategy coordination and involvement plan should be done at the critical and early stages of the formation of the plan. Identify key stakeholders whose input should be solicited early in the process and at critical stages of the watershed protection planning

2.0 Introduction

The Hawaiian Islands are unique in their geology, geographic isolation, species endemism and their beauty. Rising 16,000 feet from the ocean floor at sea level, the tallest island rises nearly another 14,000 feet more, while the smallest barely tops the surface. The Hawaiian archipelago is a 1,500-mile chain of volcanic islands and atolls, created over more than 20 million years. Formed by volcanic eruption, shaped and molded by winds, wave action, erosion, rain and even ice, Hawaii is also unique in its hydrologic qualities. Volcanic basalts include some of the most permeable formations on earth. Given the steep,

mountainous terrain of much of the islands, highly permeable rocks and soils are very conducive to water recharge in some areas. In other areas, denser lava flows, ponded lava, deposits of alluvium or volcanic ash, or rifts and dikes help to contain water, even creating warm, high elevation brackish water pockets in some places. Surrounded by water and blessed with some of the wettest places on Earth[1], Hawaii nevertheless is located in a fairly arid area, with rainfall in the open ocean surrounding the islands averaging only 25 inches to 30 inches per year.

The secret to Hawaii's natural abundance of water lies in a convergence of winds upon its richly forested mountains. The key role played by Hawaii's forests in supporting recharge has long been recognized. In 1902, US Forester G.M. Griffith wrote, "Forest Protection means not only increasing the rainfall, but more important still, conserving the water supply. The future welfare and agricultural prosperity of the Hawaiian Islands depends upon the preservation of the forest." Hawaii's native forests in particular have evolved into efficient ecosystems that capture and store appreciably more water than any other natural milieu. The forested watersheds, both native and non-native, are vital recharge areas for Hawaii's underground aquifers and a dependable source of clean water for its streams. Fresh water is not an infinite resource and its high quality, quantity, and sustainability are essentially linked to the existence of forested watersheds.

At the turn of this century, public and private concerns helped set-aside over 1.8 million acres of forest cover into forest reserves further protecting Hawaii's water resources. Today,

[1] Mount Waialeale on Kauai receives over 400" of rain per year.

Hawaii has the 11th largest State-owned forest and natural area reserve system in the United States. However, our forested watershed is declining in both area and quality. Invasive weeds, such as Miconia calvescens, arguably responsible for the decimation of two-thirds of Tahiti's forested watershed, Tibouchina herbacea and others are spreading. Feral animals have trampled large tracts of forest, leaving areas that once boasted rich cover, moist soils and good absorptive capabilities now relatively bare, with hard-packed soils that pool water and contribute to erosion and run-off.

During the 2000 legislative session, the State Legislature in its wisdom, found that Hawaii`s forested uplands are critical for a dependable supply of clean fresh water, and requested relevant public agencies to develop a watershed protection master plan. This report complies with Act 152, Session Laws of Hawaii (SLH), 2000 and covers specific topics relating to watershed protection as well as recommendations for a watershed management approach to ensure that Hawaii's future generations have access to the quality and quantity of water that we all have enjoyed over the past 100 years.

2.1 ACT 152

Act 152 (See Appendix 1) established a seven-person watershed protection board (WPB), under the Department of Land and Natural Resources (DLNR), and comprised of the chairpersons of DLNR and Department of Agriculture, a representative from each County water agency and from the U.S. Military. The WPB was charged to develop a watershed protection master plan to include:

(1) Identification of potential watershed management areas to be protected;

(2) Development of criteria for eligible watershed management projects;

(3) Development of procedures and criteria for selecting eligible watershed managementprojects;

(4) Designation of watershed management projects, including the amount of funds needed for such projects;

(5) Development of an implementation plan for those designated watershed management projects;

(6) Identification of potential sources of funding, including appropriations, assessments, contribution, grants, donations from public and private sources, and recommendation of funding sources;

(7) Analysis of problems and issues encountered in the equitable levy, assessment, and collection of the watershed protection assessment on water users; and

(8) Any other issues designated by the board. The board was charged to submit the watershed protection master plan to the legislature no later than June 30, 2001. Act 152 sunsets on June 30, 2002.

2.2 Planning Approach

Act 152 established the objectives identified in Section 2.1, but did not legislate (or fund) the process by which the WPB should proceed to carry out these duties. Therefore, the WPD initially had to identify the resources, planning approach, and procedures to be used to develop the watershed protection master plan. Major issues that needed to be determined included:

- Defining the Scope of the Watershed Protection Master Plan.
- Identifying the methodology and resources by which the plan would be prepared.
- Determining the schedule for completing the various work elements.

At a May 2000 meeting, DLNR and the County water board directors discussed how to proceed with the project. Options considered included hiring a consultant, to be funded by contributions by the County Water Departments to supplement any DLNR funds that could be allocated to the project, or compiling the master plan using available and in-house resources of the involved agencies. Due to time and funding constraints, it was eventually agreed that DLNR and water board staff would provide in-house staff resources and rely on compiling existing information on watershed management in Hawaii to prepare the watershed protection master plan. In July 2000, the Watershed Protection Working Group (WPWG) was formed from the relevant participating agencies to begin the planning process for the master plan. The WPWG had significant discussion on the focus and scope of the master plan mandated in Act 152. Act 152 focuses primarily

on the need for protection of forested watersheds for the enhancement of aquifer recharge and stream flow. The legislation specifically “recognizes that fresh water is not an infinite resource and that its high quality, quantity and sustainability are essentially linked to the existence of forested watersheds.” Act 152 also calls for the development of a watershed master plan.

A significant issue that required early resolution was whether the master plan should solely be a plan for forested mountain recharge areas or expanded to include the makai watershed areas as well as polluted runoff control for streams and coastal waters. Act 152 does not limit the master plan to forested watersheds, nor preclude the master plan from encompassing the entire watershed, from the mountains to the sea or the Ahupua’a land division concept.

In light of the multiple constraints of funding, data availability, and the mandated short time frame for completion of the master plan report to the Legislature in July 2001, the WPWG recommended, and in April 2001 the WPD agreed that a phased approach would be necessary. The phased approach would allow the initial report to focus in on achievable targets based on the priority identified in Act 152 of the forested recharge areas. Expanding the watershed master planning effort to include the entire Ahupua’a would be the focus of a subsequent master planning effort. Ultimately, a total of four phases have been identified, as follows:

- Phase 1 Framework for the Watershed Protection Program

- Phase 2 Watershed Assessment and Prioritization (Mauka Areas)
- Phase 3 Watershed Master plan for the Mauka Areas
- Phase 4 Watershed Master Plan for Mauka and Makai Areas (Ahupua'a)

Several factors point to the need to begin with the mauka reaches. Ultimately, the health of the entire system relies on the flow of clean water, which flows mauka to makai. The mauka reaches, however, could be equated to the foundation of the system, and before addressing the many and diverse needs of the rest of the system, it is fundamentally important to take care of the foundation. Other important considerations include recognition that watershed basins, as defined by drainage regimes are joined at the top of the mountain, and threats to intact systems at these elevations can affect multiple "watersheds" or ahupua'a. The mauka forests arguably harbor the most remaining intact native communities. Finally, the mauka watersheds are the most critical for maintaining and supporting the continued stream flow and ground water recharge for the islands. This four-phased approach will provide a comprehensive examination of potential watershed projects statewide. This proposal is not intended to preclude or limit the presence of existing watershed partnership activities or projects.
It is important to explicitly state and reinforce to the many stakeholders and constituents interested in watershed management, that many issues, particularly those of the makai reaches of the watershed, are not specifically addressed in this plan. It is hoped that these issues will be addressed in phase IV of the masterplan.

Phase I will address the specific items in Act 152, but it will also provide a framework that can be used to guide the survey, assessment, and stakeholder involvement that is necessary to develop the comprehensive master plan in a subsequent phase, should funds become available. The phased approach will also recognize the limitations of the exiting data to adequately assess the health of each watershed, and the time and resources involved to conduct a thorough assessment. The watershed master plan should provide a framework that not only protects forested watersheds, but also recognizes the important inter-relationship that the entire watershed “ahupua’a” has on our groundwater aquifers, streams and near shore waters. Beyond Act 152, expanding the watershed master planning process to encompass the entire watershed or ahupua’a, would necessitate the participation from other agencies, including those with program responsibility for polluted runoff control under the Coastal Zone Management and the Soil Conservation and Clean Water Acts. Ultimately, there will need to be a holistic approach that has the potential to gain broad financial, agency and community support.

If the WPB is to continue this planning effort, it will need staff support. A watershed protection partnership coordinator would advise WPB, help pull the planning together incorporating scientific methodologies, soliciting stakeholder and community participation, and liaisoning with existing watershed partnerships. Again, this proposal does not intend to interfere or impede existing watershed partnership.

3.0 Hawaii's Forested Watersheds

The Hawaiian archipelago consists of 132 islands, islets, and reefs extending for 2574 km from northwest to southeast in the Pacific Ocean between about 19 and 22 degrees N latitude. The eight major islands have a total land area of approximately 17,000 square kilometers (Juvik and Juvik, 1998). The climate is subtropical with temperatures ranging from below freezing on the tops of the higher volcanoes to 36 degrees C at sea level on the leeward (south and west) coasts. The dominant rainfall pattern is established by the trade winds that release their moisture as they reach the steep volcanic mountains. As a result, the greatest rainfall occurs on the windward (east and north) sides of the islands. The winds become warmer and drier and rainfall lessens as one proceeds down the mountains and onto the plains on the leeward sides of the islands, producing a semi-arid climate in many areas. The interaction between topography and wind patterns also produces large variations in rainfall over relatively short distances and elevation gradients, from as low as 250 mm annually on the leeward coasts, to as high as 11,300 mm annually in windward mountain areas (Giambelluca and Schroeder, 1998).

Since the islands are mountainous and of limited size, most watersheds are small, and streams tend to be short and flashy. Nearly all streams are rain-fed, originate in steep terrain in the mountains, and flow quickly to the sea. Perennial streams and small rivers partially fed by seepage from perched groundwater resources exist on the older islands of Kauai and Oahu. However there are fewer perennial streams on the younger islands of Maui and Hawaii and on the smaller islands of

Molokai, Lanai, Kahoolawe and Niihau. Perennial streams are also rare on the leeward sides of all islands (Franco, 1995).

The secret to Hawaii's natural abundance of water lies in a convergence of winds upon its richly forested mountains. Northeasterly trade winds gain moisture and warmth as they flow for thousands of miles over the tropical Pacific. As these winds reach the islands they are deflected up slope, cooling as they rise and causing moisture to condense. From equatorial regions to the south, air heats and rises, flowing toward the poles. Meanwhile, high, cold air from Polar Regions sinks and flows toward the equator. High elevation cool winds traveling from the northeast subside toward the ocean surface. This subsiding air forms a layer that blocks the rise of the trades up the mountains. The result is a subsidence inversion known as the trade inversion. This trade inversion results in a layer of warmer air between 4,800 and 7,000 feet. When the warm, moisture-laden trades rise up the mountains, this inversion layer holds down the rising air. This convergence of moisture-laden air leads to the condensation and release of moisture.

If not for Hawaii's mountain forests, most of this moisture would simply run off immediately to the sea. Instead, as this moisture condenses it adheres to thousands of stems, leaves, twigs, lichens and other surfaces in the watershed. The multi-leveled, thickly vegetated nature of Hawaiian cloud forests provides abundant surface area to help capture and collect large amounts of water. The mosses, lichens, ferns, leaf litter and soils of the forest floor also help to increase collection and storage value of the forest. The mist-laden air surrounding the forest, and the abundant shade from multiple levels of

vegetation, help to decrease evapotranspirative losses that would normally occur in a warm, highly vegetated region.

By breaking the impact of heavy rains, holding large quantities of water with surface tension and absorption and thus allowing a slower, more manageable impact to the ground via stem and leaf drip, Hawaiian cloud forests not only reduce the erosive impacts of freshets, but also enable higher and more sustained quantities of recharge. The sponge-like ability of the mosses and fern layers, as well as root-zone soil strata help to facilitate recharge and minimize water loss during dry periods, holding moisture and keeping the ground shaded.

Hawaii's watershed forests contribute to the high quality of the islands' waters. Forests have been compared to the kidneys in the body, which filter impurities out of the blood. Particles are removed by adhering to leaves, stems and soils. Leaves or root systems can absorb certain compounds, especially nutrients. Leaf matter and well-graded soils also help filter particles of water.

The effects of Hawaiian forests on island recharge are profound. Take for example Lana`i, one of the least forested of all the main islands, with relatively low rainfall and a sustainable yield of only 6 million gallons per day (mgd.). A 1967 State Land Bureau study investigated soils and vegetation on Lanaihale and concluded that they were more typical of an area receiving 60 inches a year of annual rainfall than of the 35-40 feet that actually fall on Lanaihale. More recently, A Numerical Groundwater Model for the Island of Lana`i, Hawaii (Hardy, 1995) estimated that over 65% of the recharge in the primary high level aquifer for that island was attributable to fog drip, and

that the loss of fog drip from Lanaihale would lead to the loss of over 50% of the water levels of that aquifer, essentially the only viable water source for the island. Lana`i is unusually dependent upon fog drip. Estimates from studies elsewhere indicate that fog drip interception by mountain forests increase precipitation as much as 30%, and recharge by 10-15%. These numbers are still substantial.

3.1 Historic Impacts

Watershed management in Hawaii began with the original settlement of the islands. Many scholars believe that the first inhabitants arrived in Hawaii from the Marquesas Islands between 300 and 600 AD, although Hawaiian oral tradition indicates it may have been as early as the 1st century AD. Archeological evidence suggests that the early migrants settled along the coasts near freshwater resources, primarily in the windward valleys, and practiced a mixture of shifting cultivation agriculture-and-subsistence fishing (Kirch, 1985). By 1100 AD and perhaps earlier, a distinctive Hawaiian culture had evolved, characterized by village-based settlements in the windward valleys of all islands. There is also some evidence of at least sporadic use of leeward areas (Kirch, 1985). During this time, social organization and resource management was dominated by extended family groups who lived and worked cooperatively under the leadership of respected elders. The community made resource management decisions including water management. As populations continued to increase, members of a given family group dispersed across the landscape from the coast up into the upland areas while maintaining family ties and resource sharing relationships. This system eventually led to the development of land units called ahupua’a (Hitch, 1992).

By the time of Captain James Cook's arrival in the Hawaiian Islands in 1778, the original forests, especially in the lowlands, had been greatly altered by over 1,000 years of intensive agriculture and certain introduced plants and animals brought by the Hawaiians. With European contact, these impacts and changes accelerated dramatically and spread into the mountain forests with new agricultural and forest uses, increased population pressures, and the introduction of more damaging plants and animals that multiplied unchecked throughout the forests.

Two specific activities had severe negative impacts on land and water resources: the sandalwood trade and the introduction of grazing livestock. Sandalwood (Santalum spp.) is a small tree or shrub that grew in the dry and semi-dry forest areas on all the major islands. The wood of these trees is aromatic and was in demand in China for use as incense and in ornamental carving and cabinetwork (Degener, 1930). Fur traders on their way from Alaska and the Pacific Northwest to China started taking on sandalwood in Hawaii and an extensive trade had developed by the early 1800's. Until the death of Kamehameha I in 1819, the sandalwood trade was a monopoly of the king who decreed that only mature trees be harvested in order to insure continued availability of the resource (Cox, 1992). However, under Liholiho (Kamehameha II), the trade opened to other chiefs, and in 1826 even commoners could privately cut and sell wood. The opening of the sandalwood trade and the growing desire of Hawaiians for foreign goods, led to the near total destruction of sandalwood forests by 1845 and the corresponding degradation of watersheds where they were found (Degener, 1930; Hitch, 1992).

Even more extensive and ongoing resource degradation was caused by the goats, cattle, pigs and sheep that were introduced into Hawaii by visiting sea captains before the end of the 18th century. Initially, harvest of these animals was forbidden by King Kamehameha I. As a result, animal populations increased quickly, and both feral and semi-feral ungulates caused significant damage to native forests and grasslands. The end of the kapu system in 1819 allowed harvest of these animals, and the arrival of whaling ships increased the demand for cattle for provisions. However, livestock damage to native forests and to watersheds through overgrazing and erosion of steep slopes was recognized as a severe problem throughout the 19th century (Cox, 1992), and remains a problem today.

3.2 Early Watershed Management Programs and Legislation

The traditional ahupua`a system of watershed management recognized the need for maintaining an intact and functioning ecosystem from the highest mauka reaches to the reefs makai. However, this system also recognized in practice the fact that appropriate management and use of the watershed varied with location and elevation. Upper reaches were often reserved for infrequent gathering and sacred uses. Certain activities, such as fire building, were kapu in the upper forests. While the lower reaches supported taro lo`i, residences, fishing and other uses, the upper reaches were wao akua, the sacred home of forest plants and animals.

In 1859, the Hawaiian Kingdom legislature passed “An Act to Authorize the Minister of the Interior to Take Possession of Whatever Land and Water may be Required for use of the Honolulu

Water Works". This Act, coming in response to a looming water crisis in urban Honolulu, marked the first time that the government asserted ownership and direct responsibility over the management of water resources (Cox, 1992). The distribution of water resources was becoming an issue throughout the Kingdom, as evidenced by the establishment by Royal decree of local water rights commissions on all islands in 1860. The water commissions existed until 1907 when, under the territorial government, they were abolished and their functions transferred to circuit court judges (Wilcox, 1996).

Although sugar had been cultivated by native Hawaiians since ancient times, and efforts to commercially cultivate sugar in the islands had started as early as 1835, the industry did not take off until the passage of the Reciprocity Treaty between the United States and the Kingdom of Hawaii in 1876 (Morgan, 1948). The Reciprocity Treaty allowed Hawaiian sugar to be imported into the United States duty free and effectively opened the market to Hawaii producers. Sugar requires large amounts of both water and sunlight for optimum production. So, sugar planters sought permission to construct irrigation works, locally known as ditches, to divert water from windward sources to prime cane lands in leeward areas. This process was facilitated by the passage in the Kingdom legislature of "An Act to Aid in the Development of the Resources of the Kingdom" in 1876. This Act empowered the government to issue licenses to individuals and companies for the capture and use of resources, including water, for the "public good". In addition, the legislature passed "An Act to Regulate the Passage of Water over the Lands not Benefitted Thereby" that allowed an individual or company to petition for right-of-way to move water over another's land. Later in this same year, the, first license to

capture and divert water for irrigation was issued to Alexander and Baldwin for the construction of the East Maui Irrigation Ditch (Wilcox, 1996).

Watershed protection and restoration became increasingly important in the later decades of the 19th century. In addition to the sandalwood trade and grazing livestock management, another factor that contributed to forest destruction, particularly in the later part of the 19th century, was the harvest of wood for fuel on sugar plantations. However, most plantations had switched to coal and cane residue by the 1880's, so wood cutting ceased to be a major problem after that time (Cox, 1992).

In 1860, concern over the fresh water supply for the growing city of Honolulu, sparked the first public expression of awareness of forest degradation and its negative impacts on water supply. In that year, the Kingdom legislature passed an act that protected all government lands at the sources of streams on the south side of Oahu from degradation by imposing strict fines on the owners of animals trespassing in these areas (Wilcox, 1996). This was followed in 1876 by the passage of “An Act for the Protection and Preservation of Woods and Forests” that authorized the Minister of the Interior to set aside and protect woods and forest lands that were valuable either as watersheds or sources of timber. It also authorized the appointment of a superintendent to administer the resulting areas (Cox, 1992).

The need for sugar irrigation water was the driving force behind most subsequent watershed management activities. By the late 19th century, the major sources of irrigation water had been

identified and had either been exploited or plans had been made for their development. As a consequence, concern shifted from the identification of new resources to the preservation of existing ones through watershed protection (Cox, 1992). A number of planters on several islands took direct actions in the early 1880's to preserve or restore forest lands, and the first major government tree planting effort also occurred in 1882 with the planting of over 50,000 seedlings on the hills above Honolulu (Cox, 1992).

Progress was also made on the policy front in the Hawaiian Kingdom government with the appointment in 1887 of “forest keepers” for the island of Maui, followed in 1893 by the passage of legislation creating a Bureau of Agriculture and Forestry and hiring a commissioner to head it (Cox, 1992). The first commissioner, Joseph Marsden, quickly developed and generated support for a fencing program on the islands of Hawaii and Maui to protect forest areas from livestock. The Board of Agriculture and Forestry also commissioned a survey of forest lands in 1899 to identify areas where fencing and other actions were needed. Other private interests, including several plantations and the Bishop Estate, set aside large tracts of land for watershed protection. The Hawaiian Sugar Planters Association (HSPA), founded in 1895, was also active in conservation issues and pushed for stronger conservation legislation in order to insure a steady supply of abundant water for its member plantations.

Partially in response to sugar industry lobbying, in 1903 the territorial legislature passed Act 44 that complemented the Forestry Act of 1876 and facilitated the development of forest reserves (Cox, 1992) (See Appendix 2). By 1914, when Ralph

Hosmer, the first territorial forester of Hawaii, returned to the continental U.S., nearly one-quarter of the land area in Hawaii was officially in forest reserves, including most areas of highly sloping land and most major water recharge areas (Cox, 1992). The first decade (1904-13) saw the establishment of thirty-seven forest reserves totaling nearly 800,000 acres of state and private land. Private land was voluntarily "surrendered" to the Territory for watershed purposes and landowners received property tax exemptions.

A primary management goal was the exclusion of livestock from the native forests. The program was expanded in 1907 by a hunting license program to enlist the help of the general public. Along with the fencing and elimination of feral livestock came tree planting and fire control programs. Reforestation began before 1900 in the valleys behind Honolulu and reached a peak during 1935-41, when an average of nearly two million introduced trees were planted annually in the forest reserves. By the advent of World War II, the forest reserve system included one-quarter (1.2 million acres) of the land area of Hawaii. Most severely eroding areas had been reforested, and feral livestock numbers were at manageable levels. Water was still the most important product of the forest reserves, but their potential to provide other benefits became recognized.

After World War II, the plantations and associated water companies continued to construct and maintain irrigation structures, and the territorial government continued its watershed protection efforts largely focused on managing the established forest reserve lands. The 1957 Territorial legislature laid a further foundation for watershed management planning in Hawaii by establishing Forest and Water Reserve

zones regulated and administered by the Territory. By the late 1970's, Hawaii statutes provided for the creation of county boards of water supply and described their powers and duties. Generally, these boards were charged with the task of providing current and prospective domestic water supply needs. However, many agricultural and industrial water consumers with private wells, including military bases, didn't fall under the immediate jurisdiction of the boards. The County Boards of Water Supply were basically responsible for their county's supply of domestic water, but they also supplied water for commercial, industrial, and some agricultural uses.

The Groundwater Use Act of 1961 (Hawaii State Legislature, 2000, Chapter 177) had given the State Board of Land and Natural Resources (BLNR) broad powers and responsibilities to oversee, manage, and control all groundwater uses statewide, including the authority to regulate the use of groundwater in areas designated by the board as being endangered or likely to become endangered by excessive or improper use. The State's role in managing and protecting natural resources was reiterated and reinforced in 1978 by the Hawaii State Constitutional Convention (Con-Con). Amendments from the Con-Con defined new constitutional obligations and responsibilities in managing and planning growth and development. One of these amendments mandated the legislature to create a new water resources agency (the State Water Commission) whose role was to protect, manage and regulate water resources.

In August 2000, the Hawaii Supreme Court in a landmark case for water law in Hawaii and nationally, ruled that all water resources of the State of Hawaii are subject to the Public Trust Doctrine. The Public Trust Doctrine provides special

consideration for three trust purposes: domestic water use, stream restoration, and traditional and customary practices of native Hawaiian. In re Water Use Permit Applications, 94 Haw. 97, 9 P.3d 409 (2000).

3.3 Current Threats and Management Needs

Today, Hawaii has the 11th largest state-owned forest and natural area reserve system (approx. 700,000 acres) in the United States. This is augmented by a similar acreage of forest land in private ownership, and an additional 150,000 acres within federal jurisdiction (national parks, national wildlife refuges, military training areas). The forest reserves and much of the watershed within the conservation districts are in good hydrologic condition. Hawaii's long-standing policy of watershed protection has resulted in dramatic improvements from the degraded conditions that prevailed at the turn of the century.

Although we are reaping the benefits of past investments made in almost 100 years of successful forest watershed management in Hawaii, we no longer have a management program to assure we will have an effective forest watershed for future generations. Noxious weeds like Miconia, have already established populations in our mountain watersheds. With new federal and state species protection mandates as well as increased recreational demands, the State's budget for forestry and watershed resource management is now spread over a much larger set of issues. As a result, public investment in watershed management has diminished, at the same time our community's demand for water resources and attendant watershed values has increased dramatically. Private landowners own half of the remaining

forested lands in Hawaii, and there are few incentives for them to protect these areas

Despite active and effective management efforts, these watersheds face varying degrees of crisis which existing funding structures are not able to meet. For example, in East Maui, satellite populations of Miconia, the plant arguably responsible for the loss of two-thirds of Tahiti's watershed, have recently been found to be spreading outside the core population treatment area. The extent of this spread has recently been discovered to be much more severe than previously believed, and lack of sustained funding could result in permanent damage to the watersheds on Maui.

4.0 Current Watershed Management Approaches and Projects

Components of a Watershed Management Program - A healthy forested watershed is no accident. An integrated management program may include all of the following activities: fire control and prevention; stream monitoring; reforestation; detection and rapid response to remove invasive weeds; monitoring for pest insects and disease; maintenance of trails and accesses for public hunters; fencing and animal removal in priority watersheds; and public education & volunteer programs. It should include good science and community involvement, including capacity building for citizens.

4.1 Management Components

Watershed Resource Monitoring - It is important to establish a baseline survey of the resource and some clear measure of the water quality and quantity within the watershed. Measures of

forest health and species diversity are also essential. Hydrologic data collection and monitoring are essential to gain an understanding of the nature and extent of water resources, to protect limited water resources from depletion and contamination, and to assess the success of various management options to protect and restore water resources. Long-term data collection provides valuable information about the behavior and response of water resources to various stresses, such as ground water withdrawals, droughts, and deforestation or changes in forest vegetation.

Precipitation is the major variable affecting the hydrologic cycle of a watershed. In Hawaii, most precipitation falls in the form of rain. Rainfall is measured in rain gages, which may be of a recording or non-recording type. Non-recording rain gages are simply cylinders that measure the total amount of rainfall during an interval and must be emptied regularly. Recording gages register not only the amount of precipitation, but also its timing and intensity. Because the pattern of rainfall largely affects storm runoff, base flow, and ground water recharge amounts, recording rain gauges yield the most valuable data. Also, because rainfall varies spatially, several gages are desired to better estimate the total rainfall input to a watershed.

Each year, the Commission on Water Resources Management (CWRM) enters into a cooperative agreement with the U.S. Geological Survey (USGS) for the inventory and investigation of Hawaii's water resources. Under this agreement, the USGS collects basic hydrologic data and conducts area water resource investigations. The two primary goals of this cooperative agreement are: 1) to collect meaningful and useful surface-water, ground-water, and

rainfall data that aid the CWRM in their decision-making process; and 2) to provide long-term water resource baseline data for the State of Hawaii.

In a watershed, ground water and surface water are often directly connected, with water flowing back and forth from one resource to the other over time. The need for integrating surface and ground water is clear since the quality of ground water contributes to the general condition of a watershed and may serve as a medium for transporting pollutants to surface waters. Similarly, pollutants introduced into a stream may find their way into the underground aquifer. Ground water protection presents challenges that differ from those encountered in protecting surface waters, such as transport mechanisms and resource boundaries – aquifer boundaries often do not coincide with watershed boundaries and may span several watersheds. Therefore, a truly comprehensive monitoring approach must be designed to address specific questions about ground water in addition to surface water.

Although there are many factors that contribute to the overall health of a stream, one of the basic factors is adequate stream flow. Surface water data are vital to determine the flow requirements necessary to support instream uses, such as fisheries, wildlife, aesthetic, and recreational uses. Stream flows are measured by establishing a relationship between the stream water level, or stage, and the velocity of flow through a cross-section of the stream. Commonly, water level recorders, consisting of a float, counterweight, and either electronic or paper chart recorders, are installed in a gauging station to obtain a continuous complete record of discharge. From this complete record, instantaneous or mean discharges may be

computed for any time, or any period of time, during the period of record.

Ground water data are collected from wells. Often, a network of observation wells may be installed to establish ground water trends, movement, and other aquifer characteristics. Water level records are obtained from direct measurements using a steel tape, digital or electronic record from a water-stage recorder. For the purposes of aquifer protection, the most valuable data are collected from deep monitor wells, which penetrate the entire freshwater lens and extend into the salt water at depth. Data from deep monitor wells provide insight into ground-water recharge rates and aquifer sustainable yields. Continuous measurements are taken throughout the water column to obtain a conductivity profile, which enables CWRM to track the expansion and shrinkage of the freshwater lens and movement of the mid-point of transition zone (defined as 50% saltwater and 50% freshwater). With adequate deep monitor well data, trends can be established and the amount of water that can be taken without impairment of the aquifer can be bracketed. Ideally, at least three deep monitor wells should be installed in each aquifer, a makai, midway, and a mauka well, to allow a cross-section of the aquifer to be made. Under the USGS contract, ground water levels and chlorides will be collected at 120 stations.

In addition, CWRM has initiated its own deep well monitoring program. Site selection is guided by county land use plans and county water use and development plans. In 2000, the CWRM completed two deep monitor wells, one on Oahu (Waimalu Aquifer System, Pearl Harbor Sector) and the other on the Big Island (Keahou Aquifer System, Hualalai Sector). Two more deep monitor

wells, on Maui (Honokowai Aquifer System, Lahaina Sector) and a second Big Island well (Keahou Aquifer System, Hualalai Sector), are currently under construction. A baseline survey of the watershed condition and some clear measure of the water quality and quantity within the watershed is needed. Measures of forest health and species diversity are also essential.

It is also important to note that each of the county water departments have their own ground and surface water monitoring program. The counties have installed deep monitoring wells on each island and all of the counties have their own agreement for further hydrological studies with the USGS. Taken as a whole, the counties expend approximately seven million dollars per year on these monitoring and watershed activities.

Feral Animal Control - Feral animals (escaped domestic animals) are the most conspicuous threat to Hawaii's forested watersheds. There were no large land mammals in Hawaii before man arrived. For millions of years, native forests evolved without any need to develop defenses (such as thorns or poisonous sap) against grazing or browsing animals. Pigs, goats, feral cattle, and other hoofed animals that go wild in Hawaiian forests have only one predator (people!) and an ample food supply. As a result, they have destroyed large areas of forest over the past 200 years. Where they root up soil and damage vegetation, erosion is hastened and non-native weed spread is promoted. This erosion not only reduces the ability of the forest to conserve rainfall, but also carries silt to the ocean where it damages coral reefs and fisheries. Control of feral animals in key watersheds has been a priority of Hawaii's forestry programs since their inception in 1903. In remote regions where hunters seldom venture---serious damage is continuing today, especially

by feral pigs. In more accessible regions at the edges of the watershed, feral animals are important resources for hunters.

Smaller animals also may become serious pests in the watershed. Rats, feral cats and dogs, mice, mongoose, and certain non-native birds are established on East Maui and are known to destroy or compete with native species. East Maui narrowly escaped one establishment of rabbits during 1989-1991 when a careless pet owner released six rabbits near Hosmer Grove in Haleakala National Park; the Park, in what was fortunately a highly accessible area, eventually removed 100 rabbits through an intensive eradication program. Without prompt eradication, there is little question that rabbits would have numbered in the millions on East Maui by 1994.

An animal control plan should provide a balanced strategy that includes public hunting opportunities in accessible areas as well as effective protection of remote or sensitive parts of the watershed. This entails an assessment for the need for trails, roads or other access improvements in hunting areas as well as minimizing liability and other concerns for private landowners. A coordinated fencing and animal removal strategy for remote or sensitive watershed areas should be completed. Specific management units are identified based on topography and other natural features. The strategy should specify fence routes and costs, timetable and costs for systematic treatment of management units. It should also describe the systems that will be put in place to monitor animal activity and gauge the effectiveness of these programs. This monitoring will be used to improve management methods as the project grows. A plan should also lay out a program of public information, regulatory

and other measures to prevent the introduction of new pest animals to the watershed area.

Non-native Weed Control - Although many beneficial non-native plants have been introduced to Hawaii, a number of serious weeds have also invaded native watersheds and threaten their stability. Weeds are a serious problem because they displace native plants, diminish habitat for the native animals that rely on native vegetation. Some weeds displace economically or culturally important native plants, or convert beautiful forest areas into impassable, thorny tangles. Others promote wildfire. Many weeds gain a foothold in the forest by sprouting in areas opened up by feral animals, making feral animal control a necessary starting point for any serious weed control program. Other weeds may be spread by birds, or by hikers or vehicles that enter the forest with mud and seeds from other areas.

Control methods for weeds include manual pulling, chemical treatment, and biological control (the use of insects or diseases from the weed's homeland to control the weed in Hawaii). For several important weeds, no effective control method currently exists for large infestations. It is important to invest in measures to prevent additional noxious weeds from becoming established in the first place, and to support long-term research programs to improve control methods. One of the major threats today is Miconia, which has taken over 60% of Tahiti's rain forests, turning multi-layered diverse native forests into single species monocultures prone to land slides. Incipient Miconia populations have been cleared from Oahu and Kauai, but more aggressive and sustained efforts are needed for Maui and Hawaii.

A weed control plan should provide a strategy to prevent new weeds from entering the watershed area, and will target those species that pose the greatest threat. The plan should describe a system for informing the public of weeds to watch for, how to report new infestations, and contingency plans for quick removal of reported infestations. For established weeds, a plan should determine which species merit control work and will develop a coordinated interagency approach for controlling these. As in the Feral Animal Control program, the plan should also identify clear methods for monitoring the success of weed control efforts to aid in refining management techniques. It will identify problem species for which no effective control method exists, and set priorities for research to develop improved methods.

Pollution Runoff Management-Ala Wai Watershed Program

In addition to watershed partnerships, there are other partnership efforts that are underway including the Ala Wai Watershed Program, which is a community-based program, spearheaded by the Ala Wai Watershed Association (AWWA). The AWWA is a community-led group with EPA and State funding for the purpose of promoting watershed stewardship and improved water quality in the Ala Wai Canal. The watershed includes all of the land area that physically drains into the Ala Wai Canal, the near shore waters and the submerged lands extending to and including the reef.

The mission of the AWWA is to improve and maintain the water quality in the Ala Wai Canal and its watershed through a community-based effort. Their vision of the future of the Ala Wai Watershed includes significantly improved water quality, increased community interaction and involvement, additional

environmental education for the children, and an innovative stewardship partnership between the communities, private and public sectors. The AWWA has engaged in several stream restoration projects within the Ala Wai Watershed. The restoration of streams prevents stream bank erosion and serves as a physical and visual reminder of the environmental value of these natural elements of the urban landscape. Stream restoration is one of the most effective means of improving public stewardship in the watershed and it helps to reduce dumping, littering and waste disposal into storm drains and streams. The AWWA has also been involved with many other community-based projects in an effort to improve the water quality in the Ala Wai Canal and its watershed.

Management Infrastructure - Management of large forested watershed requires a system of suitable trails, roads, shelters, helicopter landing sites and other basic infrastructure to support the work of staff and the use of the area by the public. These improvements must be designed and maintained to minimize any unwanted impacts, such as overuse of sensitive sites, inadvertent introduction of weeds on hiker's boots or vehicles, heightened liability exposure, increased potential for damage to the water system, increased risk of contamination of the water supply, or encouragement of marijuana growing or other illegal activities.

A management infrastructure plan should assess the current road, trail, and shelter system and describe necessary improvements. Opportunities to combine staff resources or equipment in order to manage the watershed more effectively should be evaluated and a recommended management approach described.

Public Education and Volunteer Program - A program to build public understanding and support for the management of the watershed in the local community is needed. Educational opportunities should be provided for political leaders and interested citizen groups. Special efforts are needed to communicate with native gatherers and public hunters who have traditionally used watershed areas. Volunteer groups have proven successful in certain watershed area management activities, especially in labor intensive efforts such as fence construction, weed control, and trail maintenance in accessible areas. A community outreach program that gives public presentations, provides informational material, and utilizes concerned volunteer groups will help develop a local constituency to support watershed management activities, including citizen-based watershed restoration and training programs to support the restoration projects.

4.2 Watershed Partnerships in Hawaii

Watershed partnerships are voluntary alliances of public and private landowners committed to the common value of protecting large areas of mauka forested watersheds for water recharge and other values. The successful creation of the East Maui and West Maui Mountains Watershed Partnerships has reinvigorated the historic cooperative partnership of public and private sectors working together to protect essential forested watershed recharge areas in Hawaii. These partnerships encompass over 100,000 acres of some of the best native rain forests within the state. In 1999, two other watershed partnerships were formed; the Koolau Mountain Watershed Partnership on Oahu and the East Molokai Watershed Partnership. The Koolau Mountain Watershed Partnership spans over 100,000 acres and has an estimated

sustained yield of over 133 billion gallons of water each year. A watershed partnership for the island of Lanai was established in October of this year.

Each partnership has taken a unique approach, largely driven by the mix of landowners, the current status of the watersheds, and the nature of the threats. Watershed partnerships are the best approach to manage large forested watersheds today in Hawaii for several reasons:

- The entire watershed recharge area needs protection and this requires the involvement of all major landowners. Each part of the watershed area is affected by the health of the neighboring parcels.
- Even when combined, the resources of the watershed partners are limited in relation to what is needed to protect the entire watershed. These limited resources must be carefully managed in order to address the threats to the watershed. A combined effort will take advantage of economies of scale for large fencing projects and other infrastructure needs. It also promotes sharing of technical expertise to make each partner more effective.
- Threats such as feral animal and invasive weeds do not respect parcel boundaries. By working together, the partners can be more effective in controlling these threats wherever they occur.
- Success in large scale watershed projects depends on community involvement and support. Cooperation among the major landowners and a clear plan for the watershed are prerequisites for widespread community support. The planning process also provides a forum for public input.

Other key regional watershed areas where watershed partnerships would be effective include the Kohala Mountains and Hualalai Mountains on the Big Island of Hawaii, the Waianae Mountains on Oahu, South Maui, East Molokai, and Kauai. There is not a single approach to forming partnerships. It is driven largely by the mix of landowners, status of the watersheds, and nature of the threats. A key element in partnerships is that all partners agree to look for funding sources, not only to provide the funding resources needed for management, but also to help leverage existing Federal, State, county and private funds. Management activities on the ground will vary according to the size of the area and the activities needed.

4.3 Maui County

The East Maui Watershed Partnership

The East Maui Watershed covers over 100,000 acres. Its elevation extends down to only a few hundred feet, and rainfall varies from 40 to over 300 inches per year. Forty-eight streams originate in the watershed, thirty-five of which are perennial streams. It is also home to 400 intakes, 75 miles of aqueducts, and 7 reservoirs and boasts the largest surface water harvest in the state, at 60 billion gallons per year. The area is home to over 30 rare and endangered species, including 12 native Hawaiian birds. Even now scientists speculate that more undescribed species may be waiting for discovery in the back reaches of this steep and rugged land. Current funding levels, however, are not adequate to maintain this watershed, particularly against the current threat of Miconia calvescens. The management budget for this preserve during FY 2001 was over $500,000, and yet only about 20,000 acres received direct treatment. While treatment of priority areas does benefit the

entire watershed, and efforts shift with needs, it is still eminently important that more of this key resource area be protected, and that protective measures be stepped up.

The West Maui Watershed Partnership

The 50,000-acre West Maui Mountains watershed ranges in elevation from only a few hundred feet above sea level in areas, up to nearly 6,000 feet on the summit of Pu`u Kukui. Rainfall varies from 40 inches to over 400 inches per year, with an estimated annual water harvest of 29 billion gallons. The West Maui mountains boast some uniquely intact bog areas, as well as 100 rare native plants, 21 species of snails and insects, about 6 species of rare Hawaiian birds and the Hawaiian Hoary Bat. Threats include Tibouchina herbacea, strawberry guava, Clidemia, Christmas berry, blackberry, Pampass grass, fountain grass, rubus ellipticus and other weeds. Pigs and cattle threaten upper reaches.

Lanaihale

Lanaihale is about 3,370 feet high, with the summit watershed extending down to about 2,300 feet in places. The proposed summit fence, Phase I of watershed protection efforts in Lana`i, will cover about 3,600 acres. Unlike the East and West Maui Watershed Partnerships, Lanaihale does not boast phenomenal water harvests. It is, however, the most important factor in retaining the recharge to the islands small, but only fresh water aquifer. The summit receives roughly 35-38 inches of rain per year. The sustainable yield of the high level central aquifer is 6 mgd, less than 1/10 the next smallest sustainable yield in the main Hawaiian Islands. This small watershed is

home to 33 species of flowering plants that are considered either endangered, potentially endangered, or species of concern.

The hydrogeology of Lanai is unusual, with the predominance of high-level water, and at least one high-level brackish well which shows evidence of geothermal heating. Vast areas of Lana`i are essentially denuded, and the remaining intact forest is shrinking. However, models indicate that without this forest, the islands only freshwater aquifer would likely be reduced by half. The main water purveyor and developer of water on the island is Lana'i Company, which currently has a funding commitment for resource protection of over $100,000 per year from the forest stewardship program alone that is scheduled to increase steadily to more like $200,000 a year over the next 10 years. Because of the severity of the loss of forest, the concern among the citizens is notable. More than a half dozen fencing options were discussed at numerous community meetings, and consensus was reached on the desired option. The fence project has been broken into phases, and 2/3 of funding for the first increment has been obtained. More funds are needed, and soon, if this island is to avoid losing its sole aquifer. The Board of Land and Natural Resources this May approved a Forest Stewardship contract for the Lanai Company that will provide critical seed money for this project.

East Molokai

In 1998, a community-wide planning process identified watershed protection as critical to reviving Molokai's rural economy and preserving its way of life. This planning process led to the formation in 1999 of the community-led East Molokai Watershed

Partnership, which has 13 participating agencies. As its first project, the partnership chose to control the goat populations in the adjoining Kamalo and Kapualei ahupuaa, which are at the heart of the watershed. By protecting the rich native forest on top, and restoring the land directly beneath it, fishing and farming activities along the coast will benefit. A five-mile long contour fence is currently being constructed at an elevation of 3,000 to 3,500 feet to provide a barrier, preventing goats from damaging the lush rain forest above. The partnership is now preparing for the second phase of the project. To promote recovery of the vegetation in the area below the fence, there will be a community-hunting program to thin out the goats and other feral animals. The hunting program will also provide food for the community. Participating landowners are also opening up their lands to the hunters.

4.4 City and County of Honolulu

The Koolau Mountains Watershed Partnership

The Koolau forests are a primary water resource for the island of Oahu with an estimated sustained yield of over 133 billion gallons of water each year. They also harbor thousands of Hawaii's native species and natural communities, including many that are rare and endangered. The Koolau Mountains watershed spans 98,000 acres. The area includes five major aquifers that have significant value. Land uses associated with the watershed vary greatly from agricultural, military, recreational, and conservation.

On August 4, 1999, a group of both government and private landowners officially formed the Koolau Mountains Watershed

Partnership (KMWP) by signing a Memorandum of Understanding. The initial membership included six of the major landowners who own approximately 80% of the total acres within the Ko'olau watershed. These are: Kamehameha Schools, State of Hawaii (Dept. of Land and Natural Resources, Dept. of Hawaiian Home Lands, Agribusiness Development Corporation), U.S. Army, City and County of Honolulu (Board of Water Supply), the Queen Emma Foundation, and Bishop Museum. In addition, three new landowners have signed on as active partners. They are Manana Valley Farm LLC, Tiana Partners/et.al., and Dole Food Co, Inc. Thirteen other landowners and non-landowners are considered associate members. For example, The Nature Conservancy of Hawaii (TNCH) is willing to provide invaluable support through their experience in managing their Reserves based on TNCH organizational mission. Though every member may have different priorities and mandates, all share the common commitment of protecting the Ko'olau Mountain watershed. Through this alliance the partners are committed to provide assistance and support of holistic management activities on a sustainable basis.

Partners of the KMWP agree that the first priorities are to develop a shared management plan and hire a coordinator to implement the plan with partners. Completion of the plan will identify key threats and propose actions to be addressed by the partnership. The management plan will provide the "blueprint" to direct key actions designed to protect the Ko'olau Mountains watershed. A competent coordinator will assist KMWP. Currently, the partnership is led by signators of the Memorandum of Understanding with administrative oversight provided by the State Department of Land and Natural Resources.

The key threats to the survival of the Ko'olau Mountains watershed are invasive alien plants (e.g. Miconia, Clidemia, strawberry guava, etc.), invasive alien animals (e.g. feral pigs, rats, mongoose, insect pests), and wildfire. Other threats are human disturbances, such as uncontrolled recreational mountain bike riding, illicit cultivation of contraband, illegal commercial tour activities, and unauthorized clearing and extension of hiking trails deep into native regions of the watershed.

5.0 Act 152 Water Protection Master Plan

5.1 Identification of Potential Watershed Management Areas to be Protected

Although Act 152 did not restrict management to the mauka forests, analysis and review of data represented in GIS Arc/View layers reveal a congregation of several resource values in these areas. Rainfall tends to be higher, stream flows more steady, & aquifers richer when supported by watershed forest. Unique species are more prevalent. The convergence of resource values in these areas supports their priority as key watersheds for the State.

Not surprisingly, these areas made up the bulk of the Territory of Hawaii's Forest Reserve system in the 1920's, which included about 1.8 million acres of both public and private lands, the primary purpose of which was to protect watersheds. Today, these lands are basically all the same lands that comprise the Conservation District, as all the "forest and water reserves zones" were put in the Conservation District in 1961. To further refine the identification of priority watersheds, other

important resource information for mauka forested watersheds were mapped, e.g. perennial streams, intact native forest areas, and rainfall levels. Also other water information was looked at, including important wells, surface water diversions, and aquifers. These data layers helped identify additional areas for consideration not currently within the Conservation District.

There are five existing watershed partnerships that are currently being managed to protect the forested mauka areas. The five watershed partnerships are:

Name	Acres	Formation/ Comments
East Maui Watershed Partnership	120,000	1991
West Maui Mountains (Kahalawai) Watershed Partnership	50,000	1998
East Molokai Watershed Partnership	5,000	1999
Koolau Watershed Partnership	100,000	
Lana`i Forest and Watershed Partnership	3,600	2001

In addition to the existing watershed partnerships, there are other areas that are being considered for watershed partnership protection. They include:

Name	Acres	Ownership
Waianae Mountains Watershed	30,000	Federal, State, County, Private
Kohala Mountains Watershed	80,000	State, Private
Hualalai Mountain Watershed	50,000	State, Private
South Maui Watershed	18,000	Federal, State, Private
East Molokai Mountains Addition	18,000	State, Private

Maps of each island that show the State Conservation Districts, rainfall isohyet or lines of equal rainfall, with a highlighting at 30 inches, combined with important wells, surface water diversions, and aquifers, as well as perennial streams can be found on the DLNR/DOFAW website (www.state.hi.us/dlnr/dofaw Watershed Protection and Management Program, Watershed Partnership Maps)

Within each of these watershed partnership areas, however, additional evaluation is needed at a watershed-by-watershed level, to add more specificity and allow a prioritized ranking to identify what is significant and what is not so significant about each watershed management area. The data on these areas are limited, dispersed and otherwise unavailable. Much more intensive ground survey work is required to assess each watershed within these regional areas in order to identify and prioritize effective protection projects, and focus limited agency, community, stakeholder resources and available funding. In Section 5.2, an example of a possible decision matrix procedure will be referenced to illustrate a watershed evaluation and prioritization process whereby eligible watersheds protection projects could be defined.

5.2 Development of Criteria and Procedures for Eligible Watershed Management Projects

The selection of eligible watershed protection projects among the hundreds of watersheds in the state requires a procedure to assess each watershed and develop a weighted ranking system based on important watershed criteria. This allows the identification and prioritization of important watersheds that

would qualify for effective projects, such as resource monitoring, fencing, and eradication of feral animals and invasive plants that would best benefit the resource values for each watershed.

The assessment of each watershed management project can be facilitated by the development of a set of criteria that will identify the physical, social and cultural parameters of each watershed. There were two basic groups of criteria that could apply to watershed management projects, 1) Watershed significance criteria based on resource values or conditions that impact water quality and quantity, and 2) the ability to deliver effective watershed protection programs. Some examples of each criteria is provided in Appendix 3.

In an ideal world, all of the following data elements for each criterion would be gathered and analyzed where appropriate. This would provide an assessment of the state of each watershed area, and a means to identify, plan, and budget for specific management actions. Some priority actions may be suited for specific areas (e.g. weed control) while others would be more effectively achieved through county or state-wide efforts (e.g. public education).

An evaluation methodology that utilizes a weighting factor to assign weights to various evaluation criteria and to determine the score of various watersheds in relation to each specific criterion can be developed. Appendix 4 shows evaluation criteria examples that are being considered. The purpose of the weighting factor is to proportionately assess the relative significance of the various evaluation criteria toward the

objective of forested watersheds influence on enhancing water resources in the overall evaluation of each watershed.

Three fundamental issues should be paramount in both defining project eligibility and in weighing and selecting applicant projects. These are:

- the degree of urgency or seriousness of the threat or problem to be addressed, or need of the area to be protected;
- how critical are the actions - either in terms of acreage / water harvest protected, or time-critical nature of the actions, or protective value to be gained by the proposed management. There should be nexus between the proposed actions and anticipated benefits to the effected watershed.
- applicants should be able to assert with credibility that they have the resources and wherewithal to complete the proposed actions.

Criteria for eligibility should be simple and easily understood. Information submitted for the application, screening and selecting procedures should suffice to demonstrate that some or all of these criteria have been met. Projects should not have to meet every criteria, but should demonstrate sufficient eligibility to be considered. Procedures for selection of eligible watershed projects should enable sound decision-making, without creating the need for a heavy administrative structure to implement. Procedures and criteria should generate sufficient data to facilitate the weighing of the selected parameters with confidence, and yet they should do so without being unduly burdensome for the applicant or implementing board.

A checklist of evaluation criteria data elements that might be considered is found in Appendix 5.

5.3 Designation of Watershed Management Projects, Including the Amount of Funds Needed for Such Projects

The WPB's priority for initial watershed project funding was the 5 existing watershed partnerships (See Section 4.2). Although there is not a detailed and itemized inventory of every task required in the next 10 years for watershed management, various existing plans have been reviewed. This exercise has been sufficient to provide an order-of-magnitude estimate of funding needs for the partnership efforts. There is agreement that such an effort would amount to millions of dollars.[2]

A multi-million dollar expense may seem like a lot of money, but an analysis of the resources at stake justifies the investment.

[2] For example, the Waikamoi Preserve management budget for 2001, only part of the total management effort that goes into the East Maui watershed, was $502,145. During the early days of the partnership, in 1993, the partners developed an East Maui Watershed Partnership Plan and budget. Subsequent documents, such as the East Maui Monitoring Plan and Environmental Assessment for the East Maui Watershed Partnership Fencing Program, further delineated project tasks and budget requirements. Extensive mapping and recording of the status of plant and animal communities and effectiveness of various management measures has taken place. However, the initial plan completed in 1993 still provides a basic road map to management measures and priorities. Appendix 6 is a summary of key funded implementation elements of that 1993 plan, representing an annual funding need of about $1.799 million for East Maui alone.

The West Maui Mountains Watershed Management Plan, completed in July of 1999, focuses on 6 major areas of activity: pest animal control; pest plant control; human activities management; water and watershed monitoring; building public appreciation and support of watershed management; and enhancing watershed management coordination. Total annual estimated budget requirements were $745,000, excluding those activities funded by partner agencies.

Summarizing the data, we have East Maui with an annual budget somewhere between $502,145 and $1,790,000, West Maui with a budget estimate of $745,000, Lana`i with needs between $800,000 and $1,000,000, and Molokai with an annual budget of $500,000. For Maui County alone, the funding estimate will be $3,000,000. This estimate would be overly high, except that it doesn't even touch the needs of the watershed partnerships outside the mauka areas, nor does it address the additional needs to meet the Miconia spread emergency, nor the needs of the Department to begin funding more hydrologic and aquatic stream monitoring, nor the potential South Maui watershed partnership, nor any community stewardship efforts.

In November 1997, a team of economists at the University of Hawaii began a natural resource valuation of the Koolau Mountains watershed on the island of Oahu. Their preliminary economic analysis of the amenities provided by the Koolau Mountains watershed show an estimated Net Present Value (NPV) of $7.44 to $14 billion. Amenities considered in the analysis were ground water quantity, water quality, in-stream uses, species habitat, biodiversity, subsistence, hunting, aesthetics, commercial harvests, eco-tourism, and climate control. NPV per acre was estimated at $76,000 to $143,535 with a mean annual stream of benefits of roughly $165 million or $1,700 per acre. NPVs were calculated using 3% and 1% social discount rates for the ranges. Even without exploring Hawaii's other forested watersheds in comparable depth, the authors found prima facie reasons for concluding that other forested watersheds around the state would be at least as valuable as that of the Koolau Mountains (Roumasset, J. et. al., 1997).

5.4 Development of An Implementation Plan for Those Designated Watershed Management Projects

At this time, there exists implementation plans for most existing watershed management partnership projects. These plans were complete prior to this report and are on file at the DLNR. Act 152 had initially asked for the development of an implementation plan for new watershed partnerships. However, this will require detailed analysis of watershed needs and recommendations for program management and administration, and could not be done in the limited timeframe available to complete this report. Therefore, it was the sense of the board that the implementation plan will be deferred until this important analysis is completed.

5.5 Identify Potential Sources of Funding, Including Appropriations, Assessments, Contributions, Grants, Donations from Public and Private Sources, and Recommend Funding Sources

Section 5.6 discusses in depth some of the issues that need to be addressed before assessing water use directly, which was the stimulus for ACT 152. While there remains disagreement on the specific nature of a water tax or assessment, there was a consensus that as population continues to increase throughout the state, the need to reestablish our watershed management commitment becomes increasingly important. A new paradigm for the protection of the natural water-providing systems needs to be built, and funds need to be provided to insure that Hawaii has the sustainable sources of water it needs to meet the demands of our island communities well into the future.

With the advent of federal and state species protection legislation, the DLNR's budget for watershed resource management is now spread over a much larger set of issues. As a result, public investment in watershed management has diminished at the same time our communities demand for water resources and attendant watershed values has increased dramatically. The public budgets have been slashed and the resources currently available for forest management are not in balance with the value of the water that is being harvested from the watersheds.

In areas where the vitality of watersheds has been degraded, there may be a need to physically rebuild natural systems that support water collection and recovery. In regions where private landowners hold portions of important watershed management

areas, there is a need for incentives to invoke voluntary participation in resource protection and enhancement efforts, and to fund management practices needed on private lands when investment is required to secure natural resources on behalf of the general public. Fortunately, many of Hawaii's forested watersheds are in relatively good shape, but a management budget is urgently needed to maintain the past investments made over the past 100 years.

Appendices 8 and 9 list many alternative funding mechanisms for environmental programs that could be applied to watershed protection. The WPB started discussion on each source's potential to meet the annual budget goals, nexus with watershed management, and feasibility, as well as examples of similar programs and degree to which they have been successful elsewhere. With the goal of an annual budget exceeding $10 million for state-wide protection and management of critical forested watersheds, it is recommended that more than one specific funding source will be needed.

There was agreement that a water assessment is feasible with the caveats that everyone who uses water should contribute (e.g. military, agriculture, private water users) in some form and that individual counties should have discretion in how any fees they assess are spent in their respective counties. This goes for all water users and beneficiaries of water. Counties should also have some flexibility in how contributions to a watershed management program are made. For example, watershed partnerships tend to have higher initial costs for infrastructure (fences, shelters, trails, helipads), which could be considered capital improvements. There will be lower costs for maintenance, but this must be sustained over many years.

It is important and critical to the success of the funding of watershed projects that a combination of agency appropriations, grants, contributions donations from public and private sources by all beneficiaries of watershed protection programs should be considered, as well as a dedicated source of funding whether it is a portion of an existing tax or a new assessment or tax on water use. Funding through the general fund would be more equitable in distributing the burden of this tax on all water users in the state, however it is acknowledged that general funds are subject to changing budget priorities and are not a source of dedicated funds.

There was agreement that the Conveyance Tax should be looked at as a source of dedicated funding for watershed management. Since 1993, two successful DLNR programs have had a dedicated permanent source of state funding: the Natural Area Partnership Program (NAPP), which provides state matching funds on a 2:1 basis with private funds for the management of natural resources on private lands permanently dedicated to conservation; and the Forest Stewardship Program (FSP), which provides State matching funds on a 1:1 basis with private funds for the forestry and forest management on private lands for ten-year periods. These programs are funded by 25% of the Conveyance Tax (HRS 247), which is levied each time real estate property is bought or sold, with revenues deposited in the Natural Area Reserve Fund.

The Conveyance Tax has an approximate revenue flow of $10 million a year with 50%, or $5 million, going to the General Fund. This amount could be dedicated to watershed management and help leverage Federal grants and private donations if an appropriate trust fund was established. The Legislature has already determined this tax is appropriate to be used for the

conservation of natural resources on private lands by dedicating 25% to the NAPP and FSP. The nexus is clear for use of a portion of the Conveyance Tax as the sale, development, and improvement of real estate in Hawaii puts additional pressure on Hawaii's water resources and increases the need and costs to protect watershed recharge areas.

Other states have used conveyance taxes as a source of funding for conservation programs. For example, Florida, through a similar real estate transfer tax, dedicates $300 million a year for conservation land acquisition and management.

The Twentieth Legislature has already amended HRS Section 247-7 to allow funds from the Natural Area Reserve Special Fund to be expended on watershed partnership projects after all other partnership financial obligations are met. Presently 7 watershed projects are being encumbered consisting of on-the-ground projects assisting four successful watershed partnerships covering thousands of acres: East and West Maui, Koolau on Oahu, and East Molokai Watershed Partnerships. The requests for funding of the expanding watershed partnership program are already larger than the existing excess moneys within the special fund.

5.6 Analyze Problems and Issues Encountered in the Equitable Levy, Assessment and Collection of the Watershed Protection Assessment on Water Users.

During the legislation of Act 152 testimony, the Department of Land and Natural Resources, the county water departments and drinking water associations submitted testimony relating to watershed protection that included a proposed watershed tax to

be levied solely on the county water departments to fund the watershed protection plan. The Department of Land and Natural Resources also referenced (Roumasset, J. et.al.) net present value study to provide information for assessing values and estimated worth for a typical watershed area. Although the final bill (Act 152) did not specify a watershed tax, it did direct that the watershed master plan should identify potential sources of funding including appropriations, assessments, contributions, grants and donations. Much of the testimony submitted for Act 152 may still be applicable to the development of aspects of the watershed protection master plan. A summary of the testimony that was submitted by the DLNR, county water departments and water associations during the legislation of Act 152 is attached as Appendix 7.

Problems and Issues The following is a summary of issues regarding the levy, assessment and collection processes of watershed protection assessment on water users. There are several threshold policy and legal questions that must be addressed in the levy or assessment of any fee on water users.

Policy

One of the most fundamental issues on a policy level is whether water user fees or taxes are appropriate. Should there be an assessment on one of the most basic human needs, water. On one hand, opponents of an assessment believe that it is inappropriate to tax a basic need such as water. As the air we breathe is not taxed, the water should not be taxed.

On the other hand, proponents argue that there is a cost to providing water, and without the kind of watershed protection program started many decades ago, there would be no water today.

Also, water purveyors for municipal and agricultural systems, as well as large water users, do not charge the entire cost for water to the extent that watershed management and protection is left out of the equation.

The second policy issue that has been raised is what is the most appropriate funding mechanism for the statewide programs. Some have suggested that given that everyone uses water, general funds are appropriate, as other state programs, e.g. DOE, DSSH, etc. are funded in this manner. Some others have suggested that because only certain selected groups of primarily water purveyors, municipal or agriculture, and large water users actually use and sell the water to others, that a dedicated user fee is more appropriate. They have also suggested that given the shifting priorities of general fund programs, that a dedicated fee or source of funding would better protect the very programs that protect and generate water for future generations.

It is a complex task to identify who should rightfully contribute towards the cost of maintaining healthy watersheds based on the benefit derived from it. The U.H. study identified multiple benefits, including ground water quantity, water quality, instream uses, species habitat, biodiversity, subsistence, aesthetics, commercial harvests, eco-tourism, and climate control.

Legal

Several legal issues have been raised concerning the levy of an assessment on water use. Any future proposal should be done in conjunction with consultation of the Department of the Attorney General. The following legal issues have been raised:

The user fee versus water tax. These issues of assessment and taxation should be addressed. The establishment of a user fee versus a tax may have different legal requirements. It is also acknowledged that there may be differing legal opinions on the issue.

An issue was raised on the legality of the state requiring a county agency to assess and collect a state tax or assessment. It is also acknowledged that there may be differing legal opinions on this issue. Assuming those threshold issues can be addressed, this report goes on to discuss the issues of levy, assessment, and collection of a watershed protection assessment on water users.

Levy

The levy should insure the broadest possible participation by all water users and should be addressed on an equitable basis. There are important issues of how the levy would disproportionately affect the citizens of different counties and different classes of water users within each county. If not properly designed, a watershed tax or levy could result in significant subsidies being assessed against the municipal users that could result in significant subsidies to those water users that are not on the municipal system, including agricultural ditch systems, industrial, commercial, and some government projects. There is a consensus that ideally all water users should pay. However, the issue has been raised whether an assessment should be phased in over a period of time with different users and should different classes of users be treated differently. County water departments currently charge different classes of users different rates, lesser rates for agricultural versus domestic use. One option is to assess the

fee on all users but have different rates for different users, either by type of use or quantity of use.

First, it is important to understand what segment of the population would be affected by the proposed levy. The watershed protection tax originally proposed in Act 152 placed the burden of funding the State watershed protection plan solely on the domestic water users serviced by county water departments and private water utilities regulated by the Public Utilities Commission (PUC). The proposed assessment ranged from approximately 75 cents to $1.00 per month. The tax would be borne by municipal water users to meet family needs for drinking, cooking, bathing, and laundry and outside lawn watering, and for agricultural, commercial, and industrial water users on the municipal system. It should be noted that the PUC already has ordered assessments on telephone bills for hearing impaired services and emergency relay services, and on electrical bills for monies to fund PUC regulation and provide for other expenses.

Potential inequity between counties is an issue. Based on municipal water system size, Oahu would be assessed approximately 77% of the fees collected. If the assessment is truly a fee, it should benefit the payer of the fee, which would imply that in fairness, all funds collected within a county should only be utilized within that county. This is a very important policy issue that must be considered in any future legislation of an assessment whether the monies should stay within the county that they are collected. There are two schools of thought on the issue. First, there is an apparent fairness to keep monies collected on one island or county in that county for their watershed projects. People could see a

direct benefit on their own county. Many state special funds were established to do just that, to keep the money for the programs where the money was contributed.

On the other hand, watershed protection does not always correlate exactly to the population numbers. For example, most of the watershed partnerships are currently in Maui County. The need for watershed protection projects may be more dependent on water resource conditions, e.g. drought areas rather than population centers. On this line of thinking, the funding would go to areas of great need and most worthy projects rather than greatest population.

Next, the beneficiaries of the levy should be identified. In Hawaii, major beneficiaries of watershed and water resource protection include many water users not associated with the county domestic water systems. These include the agricultural users, the military and state-owned water systems and other large commercial and industrial users. Some of these users are the major contributors to groundwater contamination, watershed degradation, and water resources degradation. On Kauai agricultural water use is the largest user of water when compared to domestic water users. Municipal use represents only approximately 2.5% of the total water used, while agriculture and hydroelectric uses total approximately 91% of all water used. State-wide, municipal water use represents only a small portion of the total water used. Maui's total water use during 1995 was approximately 360 million gallons per day (MGD). However, the Maui Department of Water Supply use was between 30-35 MGD or less than 10% of the total usage for the same period. A review of the water use data from the State Data Book clearly shows that a levy placed solely on domestic water users would

result in those individuals paying a disproportionate share of the burden relative to their actual water use.

Federal, State and private landowners will become beneficiaries of the watershed protection master plan. In Hawaii, the State and private ownership account for approximately 45% of the conservation district area respectively. Federal ownership equals approximately 10% of the conservation district area. Current watershed partnerships consist of and depend on landowner participation and support. In some cases, the landowner provides partial funding for these partnerships. Funding and support by the landowners should be a definite source of funding for specific watershed protection projects.

Public benefit is derived from improved conditions to the watershed. Act 152 should not be limited to only water resource protection, but should address and consider other watershed values (i.e. recreation, flora/fauna, wetlands, forest, biodiversity, eco-tourism, climate, land values, economics) which are all interrelated and of equal importance. It is clear that the public and community also benefit from watershed protection. A share of the cost of watershed protection should also be borne by the public and included as a source of watershed protection funds.

The watershed protection plan recommends that forested watersheds that are important for recharge should be a priority. These watersheds affect the water sources for agricultural, industrial and domestic use. As water use increases, watershed protection can be expected to become more critical as a result of land development impacts. This suggests a potential funding mechanism of establishing a license fee for new water users

related to watershed protection. A watershed license could be issued to water users based on their impact to the watershed. However, this will depend on further research and acceptance of a watershed license funding mechanism.

Assessment

The final form of watershed protection assessment should be equitable and fair. It should be designed to fairly distribute costs of maintaining our watersheds and water resources to the respective beneficiaries. This could be accomplished at the state or county level. The county water departments have expressed many concerns about the fairness and legality of having to collect a state assessment. Even though the bill did provide that the counties could also collect their costs in this assessment and collection, the county departments expressed a fundamental policy disagreement with the proposition that they should collect a state assessment. This is a serious policy matter that should be given careful consideration.

The watershed protection assessment should be based on a completed assessment and prioritization of watershed and water resource needs and issues, and accountability plan for expending the funds. The plan should include options to fund watershed protection activities. A combination of agency appropriations and grants, contributions and donations from public and private sources should be considered.

In order to determine a sound basis for a watershed funding assessment for new watershed projects, a watershed protection master plan that addresses watershed identification, watershed project selection, project implementation, prioritization and

cost should be completed before the final funding needs and assessment methods can be determined.

A commitment to funding watershed protection programs should be provided by all beneficiaries including government agencies, landowners, watershed partnerships and the public. In this area, the county water departments, on behalf of their customers, have demonstrated their varying levels of commitment to fund watershed management and water resources evaluation and protection activities.

The county water departments are already committing substantial financial resources to watershed and water resource management in the State of Hawaii. This commitment is in part driven by regulatory requirements. The domestic water users are already highly regulated by the state and federal drinking water regulations and are paying a premium price for the water they use due to the requirements to meet these regulations for safe drinking water.
In addition to the cost of compliance with Safe Drinking Water Act requirements, county water department past expenditures, including a mix of to-date and current costs, totaled an estimated $9.1 million on watershed protection and water resource management projects and programs, including:

- U.S. Environmental Protection Agency
- USGS cooperative monitoring (i.e. rainfall, stream gauging) and production and deep monitoring well resource studies
- Tri-county exploratory well drilling program
- Deep monitor well drilling projects
- Miconia plant removal project
- State Soil Conservation and Water District participation

- Private Watershed partnerships funding
- Integrated water resource planning (i.e. Oahu IRP)
- Wastewater reclamation facilities to minimize groundwater development

There are many other agencies that have technical acumen and resources to do watershed planning and funding of watershed protection projects. The Natural Resources Conservation Service and the Corps of Engineers have the authority and financial cost sharing programs to do watershed protection projects. Similar watershed programs and funding may be available thru the U.S. Forest Service and the Fish and Wildlife Service. Watershed initiatives of the State Department of Health and the State Office of State Planning coastal zone efforts are examples of state watershed protection programs. The Environmental Protection Agency funds or mandates watershed protection programs such as well head protection program, the source water assessment program and wastewater and drinking water capital improvement loans. These and other agencies and organizations should be included in the plan for their expertise and their funding mechanisms.

Funding and support by the landowners should be a source of funding for specific watershed protection projects. For example, Maui Land and Pineapple Co. is the landowner of an 8,000-acre watershed partnership in Maui. The landowner provides funding on a cost-share basis with government and other private organizations to implement watershed projects. However, there are other landowners who participate in watershed partnerships (in-kind costs) that do not directly provide funding. Therefore, landowner funding contributions should be

credited against their share of the established watershed protection assessment.

In concept, the cost assessed to each beneficiary should be based on the amount of water used by the beneficiary. A family who uses 12,000 gallons per month should not be assessed the same amount as a golf course or large farmer or military base which uses 1.5 to 30 million gallons per month. Also, a value on public or ecosystem benefit resulting from the watershed protection programs should be included in the assessment. Public use, including hiking, hunting, fishing and other recreational activities, as well as preservation of native forest and other ecosystems all benefit from the watershed protection programs.

Collection

The collection of the necessary funds for the watershed protection master plan will depend on the type of assessment that is used. If a new state assessment is approved, it could be collected at the state or county level. We note in an earlier section of the report, the grave reservations that the county water departments have expressed about a mandated collection of a state assessment.

Conclusions:

There are serious policy issues that must be addressed prior to the imposition of any assessment. Whether an assessment should be made, value of watershed protection, and fundamental questions of should all users pay, as well as equity and priorities of assessment must be considered.

Additionally, the legal issues on assessment versus taxation, equality and legal nexus of the assessment, and collection of a state assessment by county agencies must be addressed prior to the imposition of any assessment. Since it is a state assessment, the Department of the Attorney General would be the logical agency to advise any future legislature on these issues.

The ideal situation may be a combination of funding including general fund, capital improvement project funding for specific projects, federal funding, private money from landowners, private foundation grants, and a dedicated fund be it a user fee or a portion of another already assessed tax such as the Conveyance Tax.

6.0 Next Steps for the Watershed Protection Board

Act 152 sunsets in July 2002, and in the remaining year of this Act, there are many objectives that could be completed to base a more thorough budgetary proposal to the legislature. But this would be subject to legislative approval for additional appropriations. The following areas comprise potential next steps for the watershed protection board.

Watershed Protection Board:

The present board believes that should the Legislature desire to retain the watershed protection board and to extend its sunset date or eliminate the sunset date completely, that three areas need to be considered. First, the composition of the board should be reworked to include scientific, landowners, and community members. Second, the Legislature must provide funding

for additional work of the Board. The board cannot continue to function without the addition of staffing and other resources to properly get the job done. Third, one of the major functions of the board is to provide coordination between existing programs to make sure that resources are not wasted and to provide for the maximum coordination of many different existing programs.

Complete the List of Critical Watershed Management Areas:

The watershed protection master plan identifies existing and future potential forested mountain watershed partnership areas as critical watershed management areas. As partnerships are created, the boundaries of the proposed watershed management areas will be more specifically defined and revised with additional information and the input of stakeholders and agencies.

Complete the Watershed Data Collection and Prioritization Assessment:

The watershed protection master plan suggests broad criteria and a priority assessment process whereby all of the state's watershed areas will be ranked by significance and need. As the assessment process evolves, the criteria will be refined. Too many criteria will make the assessment process too cumbersome, increasing survey costs and the time needed to fully categorize all of the watersheds. Clearly, more work is needed to focus or "distill" the criteria into their essential elements and complete the watershed assessment and prioritization process in a timely period.

Develop a List of Tailored Watershed Protection Projects:

The watershed protection master plan identifies many categories of projects, such as reforestation, fencing, animal eradication, etc. that could be applied to the upcoming prioritized list of critical watershed management areas. However, each watershed is physically different and has unique needs whereby a generic list of protection projects could be implemented, but with varying levels of effectiveness. Once the prioritized list of critical watershed management areas is identified, a secondary assessment could evaluate the potential effectiveness of each type of watershed protection project that would be specifically tailored to the unique needs of each watershed management area. This step is critical to effectively utilize the limited available funding.

Secure Dedicated Funding Source(s) and Project Specific Appropriations:

The justification for a dedicated funding source, as well as project specific appropriations will be facilitated by the completion of the watershed prioritization and project assessment process and the identification of viable and effective watershed protection projects with specific itemized cost estimates and cash-flow time lines.

Integration of Various Watershed Efforts and Programs:

There are many watershed efforts throughout the state that have differing objectives, such as water supply enhancement, polluted runoff control for state receiving waters and native species restoration. While the objectives may differ, there are many

similar secondary objectives and shared benefits from any watershed restoration project. There is a need to integrate all of these efforts into an efficient and focused framework. This framework is at this time, beyond the scope of this master plan. Perhaps as the master plan evolves as a living document, the scope can be expanded to incorporate all of the efforts over the entire watershed and to:

- Better define the roles and responsibilities of all Federal, State and County agencies, landowners, organizations and community groups with respect to watershed protection programs and projects.
- Formulate an integrated and coordinated program for the protection, conservation and management of the watersheds within the state.
- Facilitate the permitting and identification of potential critical watershed resource areas where additional survey, monitoring and data collection should occur.
- Incorporate watershed management approaches, techniques and methodologies.
- Establish an overall schedule for the phased development of the watershed protection master plan and incorporating the implementation plan for near-term and long-term actions.

Develop and Implement a Stakeholder Coordination and Involvement Plan:

A stakeholder coordination and involvement plan should identify key stakeholders whose input should be solicited early in the process and at critical stages of the watershed protection planning. Stakeholders should be sufficiently informed about the progress of the planning effort and have adequate

opportunity to provide input. The plan should also show how such input was incorporated into the development and evaluation of the recommended watershed protection project.

The public participation strategy should include forums, venues and activities to solicit participation of interested agencies, stakeholders, private entities and the general public. Other possible involvement activities include interviews, surveys, focus groups, and community presentations, newsletters, utility bill inserts, fact sheets, media coverage and INTERNET web pages.

Stakeholder coordination and involvement is essential to the success of any watershed protection project. Government agencies do not have the staffing or funding resources to do it alone. Successful watershed programs utilize volunteers to implement watershed projects, reducing the costs for monitoring and other field work. In general, there is widespread support for the protection of our watersheds and stakeholders are willing to provide assistance. Often there is difficulty in defining where and how an interested stakeholder would get involved in a restoration effort and even worse, that well meant involvement would be unfocused, wasting time and energy. A stakeholder coordination plan, therefore, becomes essential to provide a focused process whereby landowners, agencies, businesses, organizations and communities can discuss watershed issues and protection projects on an equal basis.

The Hawaii's Implementation Plan for Polluted Runoff Control stated, "The State aims to promote community-based projects in watersheds by the demonstration that strong partnerships are developing between stakeholders in a community, responsibilities

are being identified and decisions to carry out those responsibilities can be made."

The plan also noted, however, that "The community-based watershed approach is not free of limitations. It is clear that communities in Hawaii are composed of diverse individuals with different views, backgrounds, and cultures. Therefore, individual views of the perceived needs of a watershed will frequently conflict. This creates a challenge for the community in terms of planning, decision-making, and agreement on goals, objectives and strategies to achieve a healthy watershed. In addition, internal conflicts can make it difficult to coordinate activities with federal, state and county governments and the private sector. Time and money can be wasted if communities fail to come to agreement regarding efforts to protect and restore Hawaii watersheds."

Clearly, stakeholder coordination and involvement is necessary and should be promoted, but the process will not be easy. Even if full consensus is not achievable for a particular watershed protection approach, it is important that agencies continue to provide an open and involved process.

Alternative Innovative Approaches to Watershed Restoration:

Some consideration should be given to alternative innovative approaches to watershed restoration. The watershed approach is defined as a coordinated framework for environmental management that focuses public and private efforts on the highest priority problems within hydrologically-defined, geographic areas, taking into consideration both ground and surface water flow. There are many approaches to watershed protection, enhancement and

restoration. Because each watershed is essentially different in physical, environmental and community settings, different innovative approaches could be tailored to increase the effectiveness of management and enhancement programs, maximizing benefits and community ownership.

The Hawaiian Ahupua`a approach to watershed management incorporates the management of the division of land which generally runs from the mountains to the sea. The diversity of resources from fisheries, timber, plants and animals and the rights of way to these resources within each Ahupua`a, emphasizes conservation and sharing of resources guided by social and cultural values. The use and sharing of the resources not only occurred between mountain and ocean regions, but also between neighboring ahupua`a. The Ahupua`a approach is quickly becoming a prevalent guide in modern land use and water resource planning.

Interestingly, watershed approaches on the mainland, in particular, the Social-Eco System model, have similar social connections to a historically, environmental emphasis (Kent, J. 2001). The public educational potential of watershed protection programs and projects are exceptional. By participating in watershed protection programs, the public will as a matter of course, become educated. The educational process, however, could be designed from the program initiation (Christensen, J. 2001).

7.0 References

Christensen, J. 2001 Intentional Learning for an Intentional Future, White Paper. The Learning Futures Collaborative, Inc., Seattle, Washington.

Cox, T. R. 1992. The birth of Hawaiian forestry: The web of influences. Pacific Hist. Rev. 61(2):169-192.

Degener, 0. 1930. Plants of Hawaii National Park Illustrative of Plants and Customs of the South Seas.

Franco, R. W. 1995. Water: Its meaning and management in pre-contact Hawaii. Project Report PR-96-02, Water Resources Research Center, University of Hawaii at Manoa. Honolulu, HI.

Giambelluca T. W. and T. A. Schroeder. 1998. Climate. In Atlas of Hawaii (Third Edition), eds. S. P. Juvik and J.O. Juvik, 49-59. Honolulu, HI: University of Hawaii Press.

Hardy, Roy 1995. A Numerical Groundwater Model for the Island of Lanai, Hawaii, State Department of Land and Natural Resources, Commission on Water Resource Management.

Hawaii's Implementation Plan for Polluted Runoff Control, July 2000, Hawaii Office of Planning, Coastal Zone Management Program.

Hawaii Unified Watershed Assessment, October 1, 1998, Hawaii Department of Health, Clean Water Branch, Polluted Runoff Control Program; Hawaii Department of Business, Economic Development and Tourism, Office of Planning, Coastal Zone

Management Program; U.S. Department of Agriculture, Natural Resources Conservation Service.

Hitch, T. K. 1992. Islands in Transition: The Past, Present and Future of HawaiiÆs Economy. Honolulu, HI: First Hawaiian Bank.

Juvik S. P. and J. 0. Juvik. 1998. Introduction. In Atlas of Hawaii (Third Edition), eds. S. P. Juvik and J. 0. Juvik, xiii-xv. Honolulu, HI: University of Hawaii Press.

Kent, J. 2001. Bio-Social Ecosystem Model, White Paper, James Kent Associates, Aspen, Colorado.

Kirch, P. V. 1985. Feathered Gods and Fishhooks: An Introduction to Hawaiian Archeology and Prehistory. Honolulu, HI: University of Hawaii Press.

Morgan, T. 1948. Hawaii: A Century of Economic Change. Cambridge, MA: Harvard University Press.

Multi-Attribute Prioritization of Streams Project, March 1998, State Department of Land and Natural Resources, Commission on Water Resource Management.

Roumasset, J. et. al., Draft Environmental Valuation and the Hawaiian Economy, University of Hawaii at Manoa, 1997).

Statewide Framework for Updating the Hawaii Water Plan, November 1999, State Department of Land and Natural Resources, Commission on Water Resource Management.

Wilcox, C. 1996. Sugar Water: Hawaii’s Plantation Ditches. Honolulu, HI: University of Hawaii Press.